

## **Weather Exposure and the Market Price of Weather Risk**

Submitted by Kingkan Ketsiri to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Finance, July 2012.

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Signature .....

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## **Abstract**

Whilst common intuition and the rapid growth of weather derivative practices effectively support the notion that equity returns are sensitive to weather randomness, empirical support is fragile. This thesis is the first study that investigates weather exposure and weather risk-return trade-off consistent with the arbitrage pricing theory (APT). It explores weather risk and its premium in the U.S. market during January 1980 to December 2009, based on three of the most weather-influenced industries.

The research starts with the construction of ten seasonally-adjusted weather measures as the proxies of unexpected temperature, gauged in Fahrenheit degree and percentage terms. The weather exposures of individual firms are estimated based on each of the ten measures and the market return. Although average weather exposure coefficients are small, the number of firms with significant estimates is more than attributable to chance and results are more profound in utilities. The weather coefficients are mainly stable over the sample period, indicating that the introduction of weather derivatives does not significantly impact a firm's weather exposure. Further investigation into summer and winter time reveals that most of the significant weather betas are found in winter. However, only a minority of firms have statistically different weather betas between the two seasons. Results are robust with respect to the ten measures.

The finding that unpredictable weather broadly affects groups of stocks has a direct implication in asset prices, as weather risk may be one of the priced factors. In this study, the weather risk premium is estimated using the standard two-pass Fama and MacBeth (1973) methodology, enhanced with Shanken's adjustments for the errors in variables problem. The tests are based on firm-level and portfolio-level regressions, assessed by different model specifications and repeated for the ten weather measures. In the unconditional setting, there is little support that the market price of weather risk is not zero. Although the estimates are insignificant, the magnitudes of weather premiums are relatively high compared with those of other macroeconomic factors in previous literature. Most of the estimated weather pricings are negative; thus, stocks exposed to weather should be hedged against an unanticipated increase in temperature. The main pricing results are robust to alternative sample sets, portfolio formations, base assets and weather measures. Nonetheless, the significance of weather premium is slightly affected by model specifications. In few cases, the pricings of weather risk are significant when the positive values of weather betas are used in cross-sectional regressions.

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